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CONMILIT

(Selected Articles)

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TITLE: JAPANESE MILITARY RADAR EQUIPMENT

AUTHOR: Chen Xiaolin

The main special point about Japan is its consistant high level of stress on electronics technology in order to use technological power to strengthen defense. The Japanese government has prohibited its weapons, ammunition, and so on from being exported. However, military electronics products were a case not included in the limitations. Looking at the coronation year 1989 "Defense White Paper" for the Heisei Emperor, military equipment is in the midst of a gradual electronization.

At the present time, Japan is already a "defense concentrated" nation which has taken a firm hold on the advanced electronic technology of the world. In particular, the areas of technology such as their basic electronics industry and component parts are advanced and their actual power is very great. U.S. weapons manufacturing companies are already, to a very large degree, dependent on the importation of Japanese component parts, such as GaAs chips used in warheads and radars, the vast majority of which are manufactured by Japanese companies. In the area of VHSIC (Very High Speed Integrated Circuits), Japan is also the nation in the world with the most potential power.

Japan's radar equipment for military uses was, in the early period, reliant on imports (principally U.S. made). Going through the development of the second, third, fourth, fifth, etc. of the various defense plans, taking production under license as the main vehicle, she gradually realized a process of conversion to domestic production. Since entering the decade of the 1980s, Japan has even more quickly made strides in the replacement of equipment and has brought in and newly set up a number of projects. Examples of these would be improved BADGE systems, a beginning of the replacement equipping of new models of active phase control array radars (XJ/FPS-3), equipping with pulse balanced Doppler battlefield observation radars JPPS-P10 and Model 81 phase controlled array radars for use with short range surface to air missiles (SAM). They recieved their first set of Aegis warship mounted radar missile systems. They installed their own test manufactured new model of machine mounted multifunction phase control array radar on 4 Aegis warships, and so on, and so on.

RADAR EQUIPMENT IN THE JAPANESE AIR SELF DEFENSE FORCE

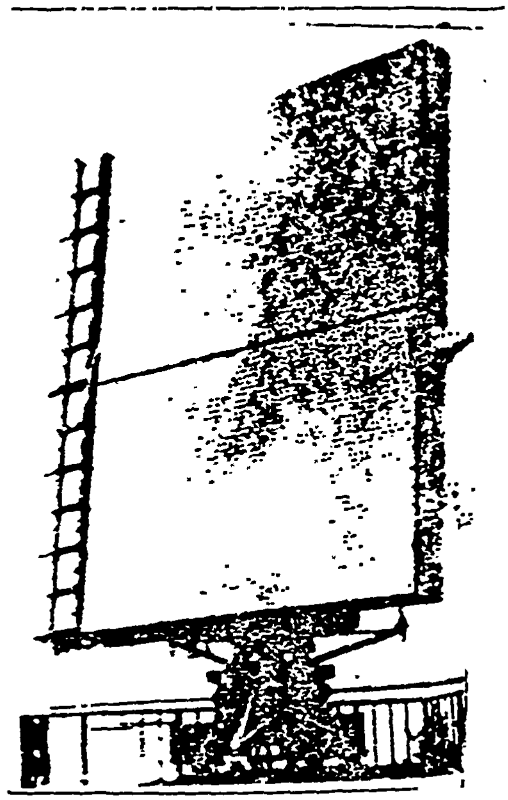
Ground Air Defense Radars

The Japanese Air Self Defense Force Group takes charge of the air defense of all of Japan. Its surface air defense radars are principally BADGE (automatic air defense warning surveillance or control) system warning radars. According to the national defense guide, Japan's number of early warning and control units is limited to 28 in number. These 28 radar sites are divided in their subordination between the various aviation front units (northern section, central section, and western section aviation front units and the southwestern mixed group). There are 4 sites on Okinawa and 24 sites in various places through the rest of the whole country. These radar stations go through the air control direction center and the air operations control center to form a system. The status of their radar equipment development is as given below.

In the early period (1960s and earlier), Japan's aviation radars were principally chosen as the U.S. manufactured AN/FPS-20 two coordinate search radars and AN/FPS-6 altitude measuring radars.

In order to raise the automated capabilities of air defense systems and their reaction speeds, when setting up BADGE systems, Japan decided to switch to a three coordinate radar. Moreover, beginning in 1962 and onward, they carried out their own test manufacturing of phase controlled arrays and three coordinate technology. In 1964, they test installed antennas. Following that, they test manufactured a successful receiving device, radiating device, and display device, etc. The Sanyo Electronics Company, in 1971, set up the solid state J/FPS-1 three coordinate 3D radar. By 1977 they had equipped altogether 7 J/FPS-1 radar stations. These radar stations opted for the use of computers to carry out processing. They had automatic altitude measuring capabilities, a search (unclear) distance of 600 km, and were a great improvement over the previous AN/FPS-20 (350 km).

In 1971, Japan's mobile security units were equipped with Japan's own domestically modified mobile type 3D radar the J/TPS-100 (that is, NPM-510). This is an S wave band radar. Its pitch is a single wave bundle or packet electric scan (frequency-phase scan). The radiating device opts for the use of intersecting field amplifier devices and linear pulse voltage technology. The radar opts for the use of digital automated moving target indicator signal processing methods. 43



J-FPS-2 Solid State Three Coordinate Radar

The whole system is capable of being used mounted on six 2.5 ton tracked vehicles. This radar is manufactured by Nippon Electric Company. This company, on the foundation of this radar, at the end of the 1970s, test manufactured a successful small solid state model of the J/FPS-2 3D radar (that is, the NPG--880). This radar opts for the use of energy management concepts, and, along with this, it opts for the use of double path structures and built-in test systems (BIT), giving it relatively high reliability. In 1981, Japan was also equipped with the J/TPS-101 radar (built by Sanyo Electronics). This radar, as compared to the J/TPS-100, possesses even better mobility characteristics and is capable of being linked up with fixed radar stations.

Due to the fact that the BADGE system, which went into service in 1968, was not capable of responding to the needs of Japanese air

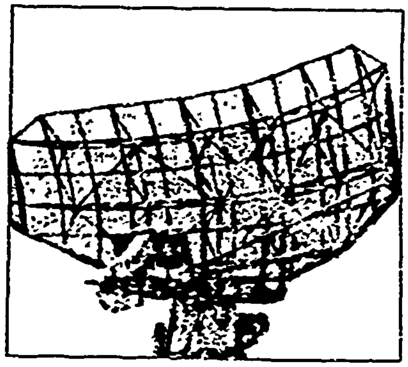
defense, in 1983, Japan got a newly test produced system. In conjunction with this, it started operations in 1988. 28 radar sites were also totally automated in the process, and flight track processing, tracking, and intercept control capabilities were very greatly improved.

At the present time, Japan is in the midst of setting up an intermediate period defense plan (1991-1995) for the modernization of Japan's air defense radars. The plan includes taking a new form of air defense radar and introducing it into the BADGE system, and, along with this, equipping even more mobile type radar stations. The plan will cost 200 billion yen (525 million U.S. dollars).

What should be brought up here is the fact that Japan's domestically test produced active phase controlled array radars have already been introduced into service. These radars (XJ/FPS-3) were test manufactured by the Sanyo Electronics Company, and had already, in 1986, been submitted for operational testing to the Japanese Defense Ministry's Technical Research and Development Department. The Japanese plan will take this type of radar and install it at 28 radar sites to act as the main air defense intercept control radar. These radars, at each site, will include both long range and short range types of radars to work, respectively, in the L and S wave bands. These radars also include a decoy radiating station appoximately 400 meters away from the basic station.

In the area of air defense weapons systems, Japan has equipped helself with a total of 6 Nike air defense missile groups and 8 Hawk air defense missile brigades. From February 1990 onward, the U.S. Patriot system will replace the Nike and Hawk systems one after the other. The Patriot system's AN/MPQ-53 multi-function phase control array radar is capable of replacing 9 Nike and Hawk radars at the same time.

The domestically produced Model 81 short range ground to air missile guidance radar, which Japan was equipped with in 1982, has a two dimensional (azimuth and elevation or pitch) electronic sweep three coordinate multi-function radar. It has a detection range of 20-30 km and is capable of simultaneously tracking 6 targets. It is used by both the Japan Air Self Defense Force and the Japan Ground Self Defense Force.



OPS-18 Seaward Observation Radar

Onboard Radars

Pincipal among the fighter aircraft with which Japan is currently equipped are the F-4EJ, the E-15J, and the F-1, as well as other similar aircraft.

In 1971, Japan began to equip herself with the F-4EJ fighter aircraft to be the successor to the F-104J as their main fighter plane. At the present time, they are equipped with a total of 6 aviation units with 127 aircraft. Originally, these aircraft were equipped with the U.S. AN/APQ-120 radar. Due to deficiencies in its downward vision capabilities, in 1976, at the time of the flight and interception of Captain Belenko (phonetic approximation)'s Soviet MIG-25, it lost the target in flight. There are now 100 F-4EJ aircraft in the process of switching over to being equipped with the "look down shoot down" capability of the AN/APG-66J radar (This radar was originally mounted on F-16 aircraft).

The Japan Air Self Defense Force currently includes 102 F-15J fighters. These aircraft began to be fielded in 1981. This type of fighter aircraft, which the Japanese call the strongest in the world, is equipped with the U.S. AN/APG-63 radar (this is a pulse balanced Doppler radar with high, medium, and low pulse balance repeat frequencies).

The Japanese-produced F-1 close air support fighter began to fly in early 1977. It was used to replace the F-86F. It is equipped with Sanyo Electronics Company produced J/AWG-12 air to air, air to ground radar.

In order to equip future fighter planes (for example, the FS-X), Japan (the Sanyo Electronics Company) test manufactured its own onboard phase control array radar. This radar antenna diameter is 66 cm with 750 modular elements in the array. In 1986, it had already been loaded on C-1 transport planes for test flights.

Besides this, the domestically produced T-2 training plane has installed on the nose portion of the aircraft the J/AWG-11 search and distance measuring radar produced by the Sanyo Electronics Company. On the Mirage reconnaissance plane, one sees installed a side-looking airborne radar (SLAR) which opts for the use of comprehensive or general aperture diameter technology. On the RF-4E reconnaissance plane, there is installed the side-looking AN/APD-10 radar as well as the front-looking observation radar AN-APQ-99 which has terrain following functions, and so on.

Aerial Early Warning Aircraft

In 1983, Japan began to equip herself with eight of the E-2C Hawkeye early warning aircraft brought in from the United States. The base for these 8 aircraft was located at Misawa, and they were used to patrol the area of the Sea of Japan (but not to include the Pacific Ocean). In recent years, they have bought another five E-2Cs. They will take delivery in the early 1990s. The E2-C's observation radar is the AN/APS-125. Its probing distance is 200 nautical miles. And, it is capable of simultaneously tracking 250 targets.

Due to the fact that Japan's requirement for observation of sea routes (for example, the key Pacific sea routes) surpasses the 3E-2C capability range, Japan is considering, in its next 5 year plan, bringing in a new early warning aircraft. The types of aircraft

selected include the E-3, P-3, and C-130, as well as other similar early warning aircraft. In conjunction with this, it is planned to combine F-15s and in-flight refueling aircraft together to form "aerial intercept units".

OTH-B Radars

Japan decided to construct a rearward scattering super observation distance radar (OTH-B). in order to increase air defense capabilities a step more. This radar is planned in the next 5 year defense plan for equipment utilization. It will require the expenditure of approximately 100 million U.S. dollars in funds. In the 1987 and 1988 fiscal year planning, it was, respectively, 6 and 36 million yen. It has already been decided to put this radar's sending station on Hahashima. Its receiving apparatus and control center will be set up on Yuokiroshima (a Pacific island 1200 km south of Tokyo). This radar's range of coverage can go from the Kamchatka Peninsula and the Sea of Irkhutsk to Lake Baikhal, the western part of China, and Vietnam.

SELF DEFENSE FORCE RADAR EQUIPMENT IN THE SEA OF JAPAN

In the Sea of Japan, Self Defense Force radar equipment includes air and sea search radars, seaward directed navigational radars, fire control radars aboard warships, and radars onboard naval aircraft, as well as other similar radars. Among these, a good many are U.S. radar equipment. This article has, for the most part, introduced shipboard radars which have been test manufactured by Japan on her own, such as, the aerial search radar OPS-1 (modeled after the U.S. SPS-6), OPS-2, OPS-11, OPS-12, and OPS-14 (Models A, B, and C), as well as other similar radars. The water surface search radars OPS-15 (modeled after the U.S. SPS-5), OPS-16, OPS-17, OPS-35, OPS-37 (mounted on old model

patrol vessels), ZPS-2 (mounted on submarines), and ZPS-3, as well as other similar radars. In addition to these, Japan also possesses the OPS-28 radar which has the capability to detect missiles at sea (both air and sea capabilities).

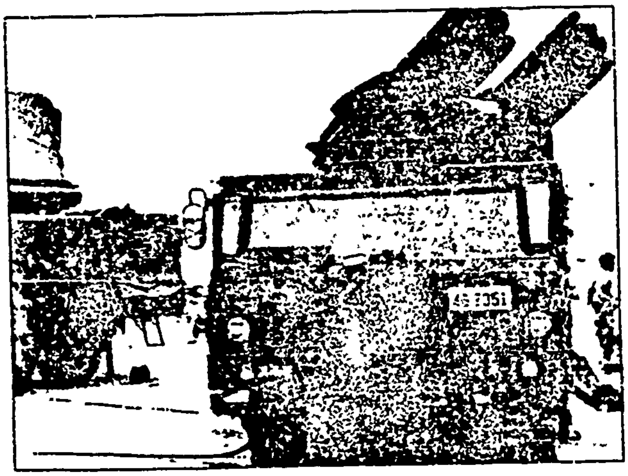
In Japan's early period in the 1950s, Ayanami, Murasame, and Akizuki class destroyers, as well as other similar types, were equipped with OPS-1 and OPS-1B (L wave band) air search radars, OPS-15 or OPS-16 (C wave band) sea directed search radars. Asahi class corvettes or escort vessels were equipped with OPS-1 air search radars and OPS-3 seaward directed search radars.

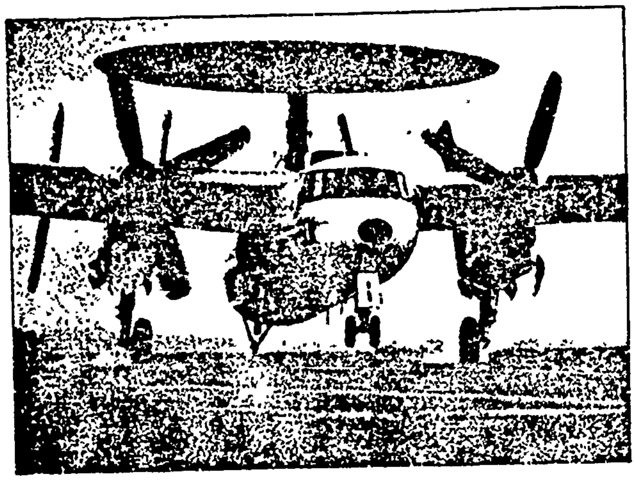
The Amatsukaze escort ship built in 1961 was equipped with the U.S.-made AN/SPS-39 radar. In the middle 1960s, Japanese destroyers (including the Yamagumo, the Takasuki, and the Minegumo, as well as other similar ships) basically reached the world level. They were equipped with sonar and, for that time, the newest anti-submarine weapon--the anti-submarine unmanned helicopter. In addition to this, they had the air and sea search radars OPS-11, OPS-14 (A), and AN/SPS-37, as well as other similar radars. Among these, the OPS-14 44 (A) was in the L wave band. Its output power was 40 kilowatts. This radar was also mounted on both the Souya minelayer and the Hayase supply ship, as well as other similar vessels.

In the early 1970s, Japan began to equip its ships with three coordinate radars. The missile corvettes Tachikaze and Asakaze, one after the other, were equipped with the U.S. AN/SPS-52B Model three coordinate radar. In 1973, Japan's destroyers and escort vessels or corvettes (for example, the Hatsuyuki) were equipped with the OPS-14B Model air search radar. This radar had a moving target indicator (MTI) function, and its frequencies were capable of rapid change. In this time period, the sea search radars with which they were equipped were the OPS-18 radars which were offshoots of the U.S. AN/SPS-10.

In 1980, Japan, in its Shirane class large model helicopter destroyers, began to field a new OPS-28 Model radar which was designed domestically and had anti-low flying missile capabilities. This radar was in the C wave band. It opted for the use of a parabolic cylinder slot array antenna. In 1986, the initially launched, improved model Hatsuyuki destroyer was equipped with the OPS-14C Model and the OPS-18 Model radars. Among these, the OPS-18 was soon replaced by the OPS-28 radar.

In Japan's next "Intermediate Defense Plan", a key project for air defense at sea was the fielding of Aegis missile destroyers. The Naval Self Defense Force plan will take the current 4 escort unit groups and reorganize them according to the "88 Fleet System" (that is, 8 helicopters and 8 destroyers). Each fleet group will be fitted with Aegis on one vessel. This vessel will be equipped with the U.S. Aegis light model system. The total expenses will be approximately 63.2 billion yen. In 1988, Japan had already received its first set of Aegis systems. This system's AN/SPY-1 phase control array three coordinate radar is in the S wave band. It is capable of handlling several hundred in-flight or marine targets.





(Left: Japanese Model 81 Short Range SAM Using Phase Control Array Radar (left) and Quad Launcher System) (Right: Japanese E-2C Early Warning Aircraft Imported from the U.S.)

JAPANESE GROUND SELF DEFENSE FORCE RADAR EQUIPMENT

The development of Japanese Ground Self Defense Force radars has been going on for a long time. As early as 1939, Japan already had warning radars. Their wavelength was 3 meters. They opted for the use of a continuous wave Doppler system (at that time, pulse balanced

systems were used in ionospheric observations and measurements). In 1940, Japan equipped herself with firing radars having 20 cm wavelengths. These opted for the use of 1000 Hertz modulated frequencies. In 1952, on the foundation of a British radar which they captured (during the occupation of Singapore) Japan began the test production of domestically produced warning and firing radars. In 1953-54, the Nippon Electric Company produced a radar imitating U.S. and German 50 cm wavelength systems, and so on, ans so on.

At the present time, the Japan Ground Self Defense Force is organized so as to have various types of intelligence, observation, and control equipment. This equipment includes battlefield observation radars, field air defense radars, weapons location radars, as well as coastal observation radars, and various other types of radars.

In the area of battlefield observation, in 1965, the Ground Self Defense Force was equipped with an easily portable short-range radar, the JAN PPS-4. This radar is in the X wave band. Its output power is 1 kilowatt. For moving single troops and for vehicles the detection distances are, respectively, 5 and 10 kilometers. In 1982, Japan equipped herself with the successor (unclear) model--JPPS-P10.

The Nippon Electric Company and the Fuji Communications Company, in imitation of the U.S. AN/TPS-25, successfully test produced the JTPS-P6 medium range battlefield surveillance radar (ground set No.1). In 1970, they began equiping Army reconaissance detachments and artillery units. This radar was in the X wave band. Against large model vehicles, its search range was capable of reaching 40 km. The JTPS-P6's that were fielded during the period of the fourth defense plan were carried on wheeled vehicles (using 3/4 ton square bed trucks).

In the realm of locating weapons, in the 1960s, Japan equipped herself with close to 40 sets of U.S.-made AN/MPQ-10 (as well as Model 10A) radars. The weapon locating radars which Japan test produced and manufactured by herself principally fall into the two types that follow. One is the mortar locating radar JAN/MPQ-N_1. This radar is based on the U.S. AN/MPQ-4 and manufactured under special license. It is a K_u wave band radar that is non-tracking. It has a search range

of approximately 10 km, and is used to supplement and replace the MPQ-10. In 1972, this radar began to opt for the use of a new model of computer and is capable of processing targets. In 1975, this radar was distributed, on average, as one set to each artillery group. The second is the artillery locating radar JMPQ-P7. This radar was test manufactured by the Toshiba Company. It began to be fielded in 1976, and opts for the use of a phase control array system. It possesses multiple wave sheaves or bundles and is capable of automatically carrying out detection and trajectory analysis on multiple incoming shells.

In the arena of field air defense, Japan, on the foundation of the U.S. AN/TPS-10 and AN/GSS-7, test manufactured on her own the JTPS-P5 low altitude observation radar. This radar is in the S wave band. It opts for the use of pulse balance compression techniques. Later, division and group air defense battalions were also equipped with JTPS-P9 radars (L wave band). In the area of fire system radars, the Japanese Army is equipped with the Hawk missile system as well as Model 81 short range SAM systems. The Air Self Defense Force has been described.

Recently, Japan has just turned its hand to the test manufacture of a divisional headquarters C^3I system (short range air defense) similar in type to the U.S. SHORAD. This type of system has the purpose of taking short range air defense and putting into under unified command and control of C^3I systems. This requires the realization of automatization of radars and rapid response.

THOMSON RADIO COMPANY DEFENSE AND CONTROL SYSTEM DIVISION

The French Thomson Radio Company (Thomson-CSF) Defense and Control System Division (Division Systemes Defense et Controle, SDC) handles aerial detection systems (principal among which is radar) as well as phase response ground and shipboard signal processing, data processing, and display equipment start ups and test manufacturing work in which it already has more than a 30 year history. SDC's total number of employees is 4,400 and, among these, are included 1,400 specialized engineering and technical personnel and administrative personnel. Its yearly average operating expenses are 5 billion French Francs. 75% of this originates from exports. Its headquarters is in Bagneux on the outskirts of Paris. Its research facilities and factories are scattered between Bagneux, Meudon-la-Foret, Sartrouville, and Toulouse, and occupy a total land area of 150,000 sq. meters.

SDC products include air defense conmmand and control systems, aerial and sea traffic control systems, naval operation command systems, battlefield radar detection systems, and other similar systems. For more than 30 years, it has produced a total of more than 4,000 sets of various models of radar and over 6,000 sets of display devices.

AIR DEFENSE COMMAND AND CONTROL SYSTEMS

SDC produces the various types of radars which are required by air defense command and control systems, as well as electro-optical equipment, and sets of signal processing and display equipment. Initially, it mostly directed its efforts toward high and medium air targets. Later, following along with changes in military air combat tactics, it put its emphasis on developing low altitude air detection systems. The scope of this enterprise is from supplying basic radar equipment and key communications systems, right up to setting up entire control centers.

In early 1955, SDC began doing research on the feasibility of high power three coordinate radars. In 1958, they, then, supplied to the French Air Force, the first Palmier observation radar. On this foundation, they followed up with research on the middle power (20 kilowatts to 40 kilowatts) Ares radar. These mechanical scan narrow

wave packet or sheaf three coordinate radars are still in use in France and a number of other countries to this day. Moreover, they will also continue to be used until the middle 1990s. These radars are still key equipment in the Nike system (NADGE, that is, NATO ground air defense).

Following along with the development of electric scanning technology, SDC, in the middle 1960s, began to test manufacture electrical scan radars. In conjunction with this, they made use of this technology and, by the end of the 1960s, test manufactured for the French Air Force the SATRAPE system. This system was one of the earliest automated three coordinate air defense command radars in the whole world, and it is still in service to this day.

At the present time, SDC air defense command and control system equipment includes TRS2215, TRS2230, and TRS22XX long range three coordinate radars; Tiger low altitude air detection radars; Mobile Control Reporting Centers (MCRC); as well as Low Altitude Reporting Posts (LARP).

TRS2215 and TRS2230 long range three coordinate radars make use of phase shift technology to realize electrical scanning. They send out signals, receive signals, and process them with systems that are totally the same. The principal distinction is in their different structures and antenna dimensions. Operational types include high altitude observation (detection distances are all 508 km).
They also include anti-jamming (the concentrating of radiated energy pointed toward the air space in which the enemy is carrying out jamming), as well as high accuracy estimation of altitude (used in the air space in which the enemy is putting out jamming in order to carry out target indication and during periods of radar silence). The special features of these two types of radars are that they opt for the use of low static receivers, automatic noise processing (ground moving target indicators) and high performance digital moving target indicator technology.

SDC, in response to the requirements of the French Air Force and on the foundation of the TRS2215/30, test manufactured the TRS22XX radar with even better characteristics. The TRS22XX opts for the use

of high power sending devices and new logic circuits. It is capable of satisfying the new NATO requirements for an air defense command and control system.

The Tiger model wide band scanning low altitude detection radar systems are of two kinds: the TRS2100 Tiger S and the TRS2105 Tiger G. The TRS2100 operates in the S wave band. Its detection range is 110 km. The TRS2105 operates in the C wave band. Its detection distance is 70 km. Their special points are that they opt for the use radar net relations, pulse compression, multi-Doppler filtering, as well as new technology for operation type program control, and so on.

AIR TRAFFIC CONTROL SYSTEMS

In this field, SDC is capable of supplying one dimensional or linear radar, two dimensional radar, accurate field entry radars, as well as instrument landing systems, microwave (unclear) landing systems, VHF omnidirectional radio signal markers, distance measuring equipment, meteorological radars, and other similar types of flight navigational and landing aid equipment. It is also capable of helping customers set up entire control centers.

Dual wave packet antennas, composite or television radar pictures, multiple radar tracking, solid state instrument landing systems, expert systems, contact sensitive display devices, ultra high resolution display devices (2,000 x 2,000) and other similar devices in a series of new technological developments and applications made in SDC's air traffic control systems are renowned worldwide. SDC also test produced the world's first single pulse two dimensional radar. In conjunction with this, they first of all realized control center software written using the Ada language.

NAVY OPERATIONAL COMMAND SYSTEMS

SDC products also include the various types of shipboard and coastal base observation, search, and fire control radars required by naval operational command systems, as well as signal and data processing display equipment.

The Jupiter II long range aerial observation radar is fitted with high gain antennas and multiple Doppler signal receiving and processing devices. It operates in the L wave band. Its detection distance exceeds 200 km. The Sea Tiger aerial and water surface detection radar possesses an identification friend or foe capability.

It operates in the S wave band. Its detection distance is greater than 100 km, and it is capable, outside of 15 km, of discovering the flight of anti-ship missiles coming in low over the water.

The Canopus all-weather close range defensive fire command instrument is composed of a Ka wave band radar and television or infrared tracking equipment. Its acquisition range for aircraft is 11 km. Its acquisition distance for missiles coming in low over the sea is 6.5 km. In conjunction with this, it is capable of receiving target indicator information coming from observation radars. The Castor II C command instrument's radar opts for the use of the X wave band in a narrow band single pulse mutiple Doppler radar. It is fitted with sending devices that are involved with rapid frequency changes. Its acquisition range for aircraft is 25 km. Its acquisition range for missiles coming in low over the water is 15 km. The Castor II J, by contrast, is a type of all-weather anti-missile fire command instrument. It is capable, under conditions of the heaviest noise and interference, of accurately tracking low altitude targets. Its Ku wave band single pulse radar possesses quick frequency change, pulse compression, and multiple Doppler signal processing capabilities. Its aircraft acquisition distance is 25 km. Its acquition distance for missiles coming in low over the water is 12 km.

BATTLEFIELD RADAR DETECTION SYSTEMS

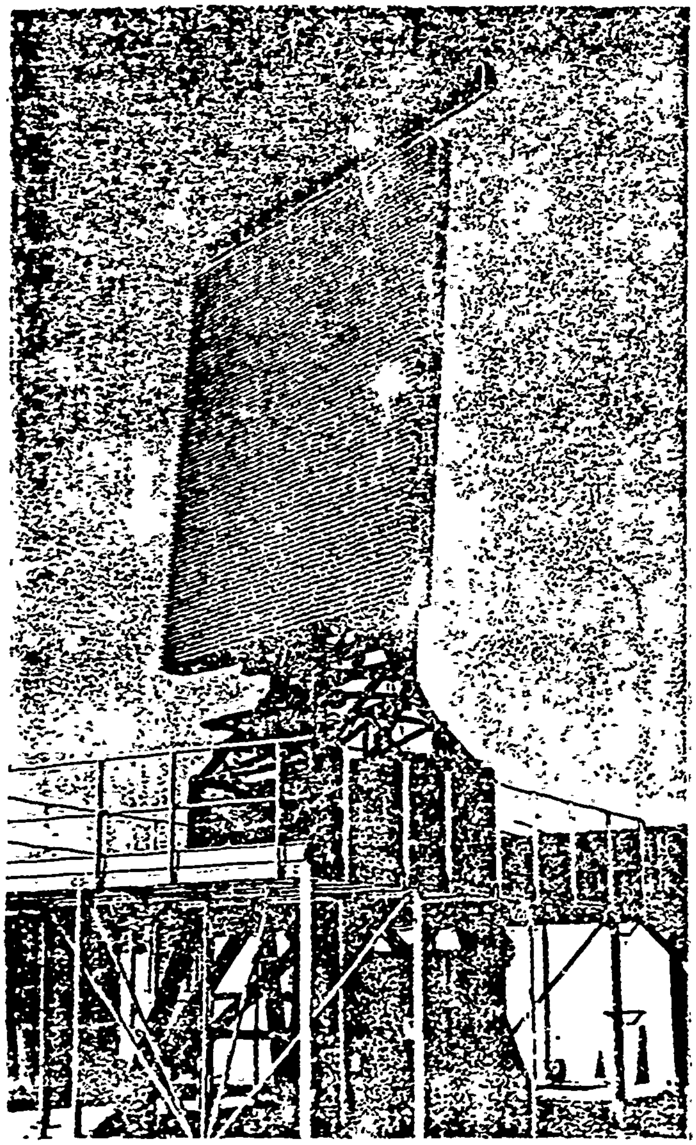
The many types of field observation, fire control, and position fixing radars, which SDC has developed and manufactured, have widespread applications. The Crotale, Roland, and Shahine mobile ground to air missile systems, as well as other similar systems, all opt for the use of radars which the division in question has developed and manufactured.

The Condor self-propelled anti-aircraft fire control radar operates in the Ka wave band and possesses a very high accuracy. The SA90 is a type of new model multiple function radar which SDC developed and manufactured to satisfy the requirements of the 1990s for air defense systems. It possesses a series of functions such as observation, acquisition and tracking, guidance, and other similar functions. In conjunction with this, it is capable of combatting

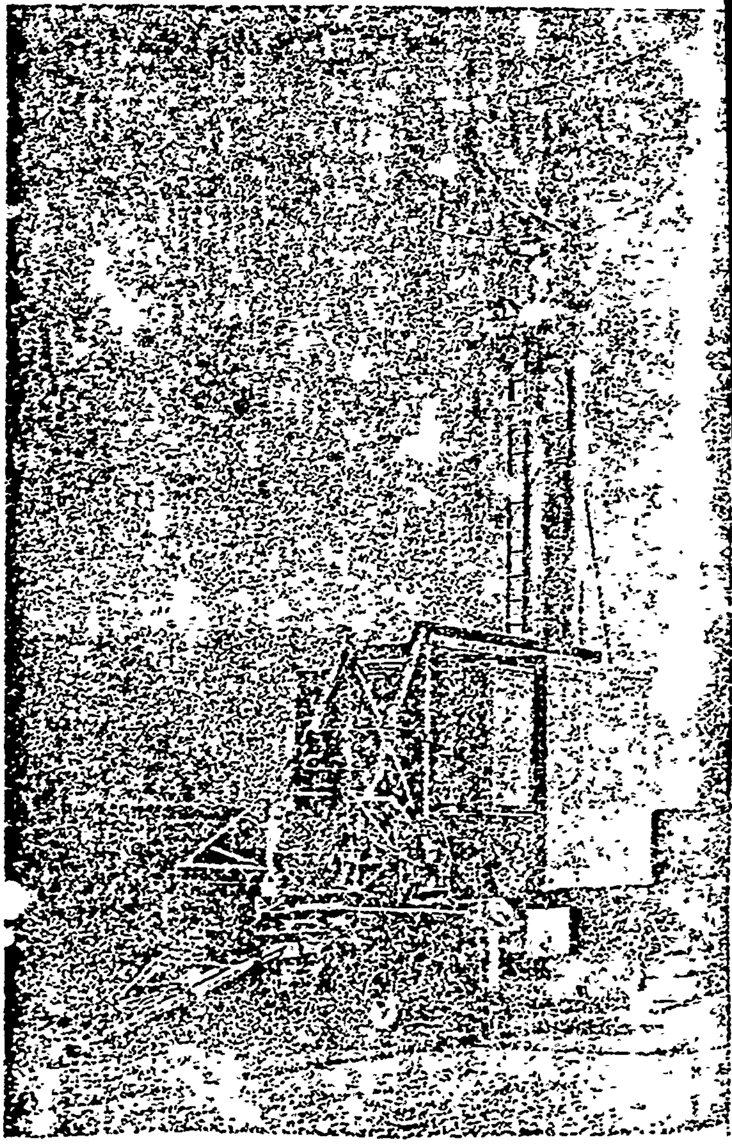
reflected radiation missiles.

The TRS2620 Gerfaut radar is a target acquisition radar which was developed and manufactured by SDC for super-low altitude air defense weapons systems. It is not only capable of detecting fixed wing aircraft. It is also effective at detecting various types of attack helicopters--in particular, anti-tank helicopters. This is a type of S wave band, wide band all-phase pulse Doppler radar. It possesses the special capabilities of rapid frequency change and identificaton friend or foe. In the case of hovering (or near) helicopters, it is capable, through the returning waves from its rotating wings, of discovering the target.

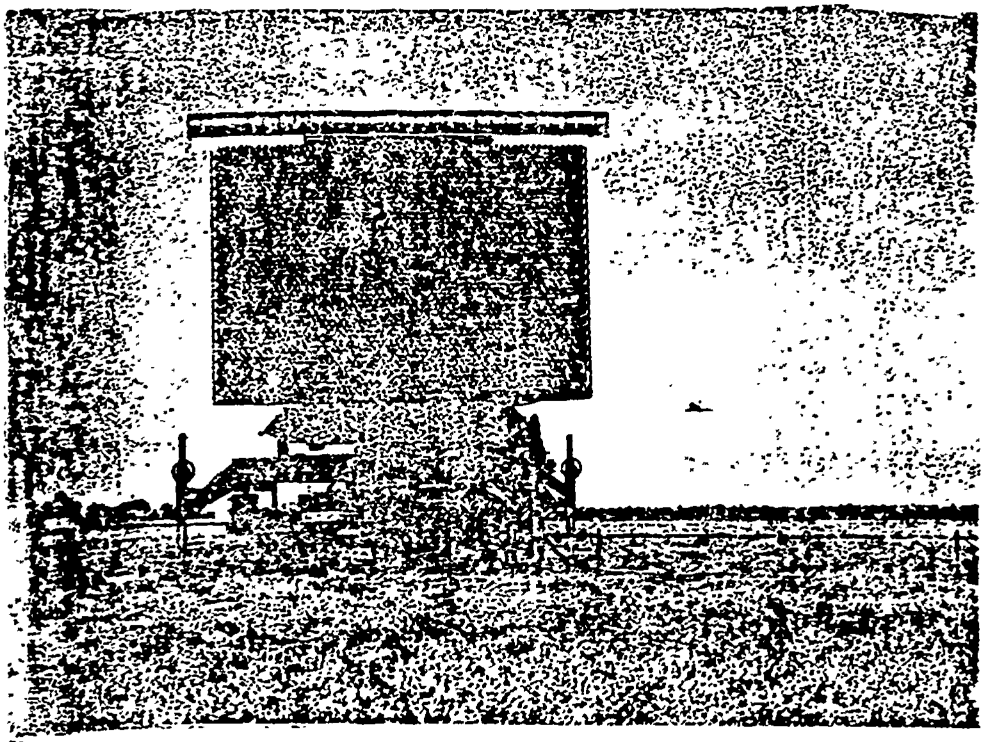
SDC, at the present time, is also test manufacturing a type of new model counter-artillery radar (COBRA). This is a type of mobile model, fully solid state phase control array radar. It is capable of accurately determining the location of enemy artillery, and, along with that, calculating the flight trajectories of artillery shells. It possesses such special features as high survivability, ease of operation, and other similar characteristics.



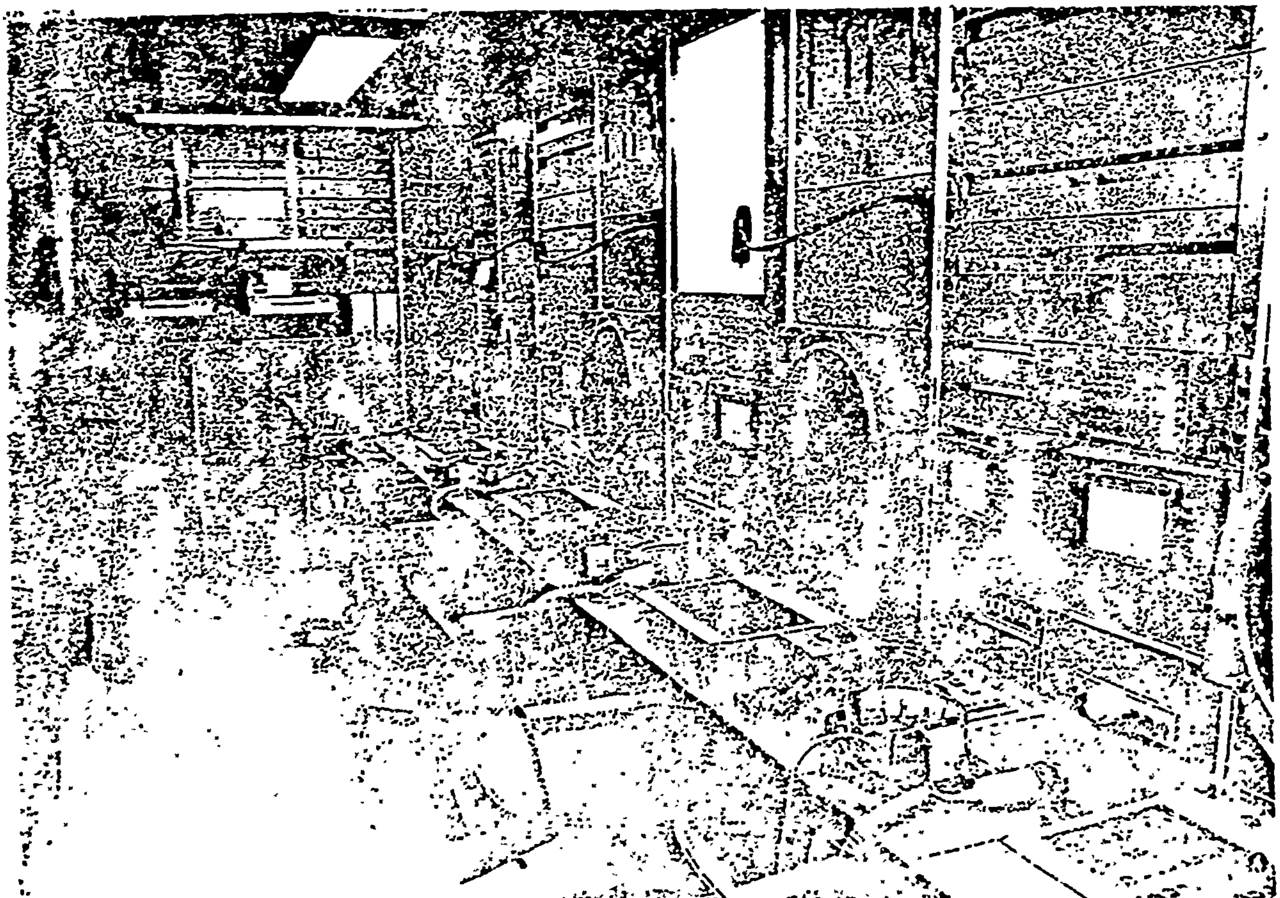
(1) TRS 2215 mobile three coordinate radar.



(2) TRS 2230 fixed type three coordinate radar.

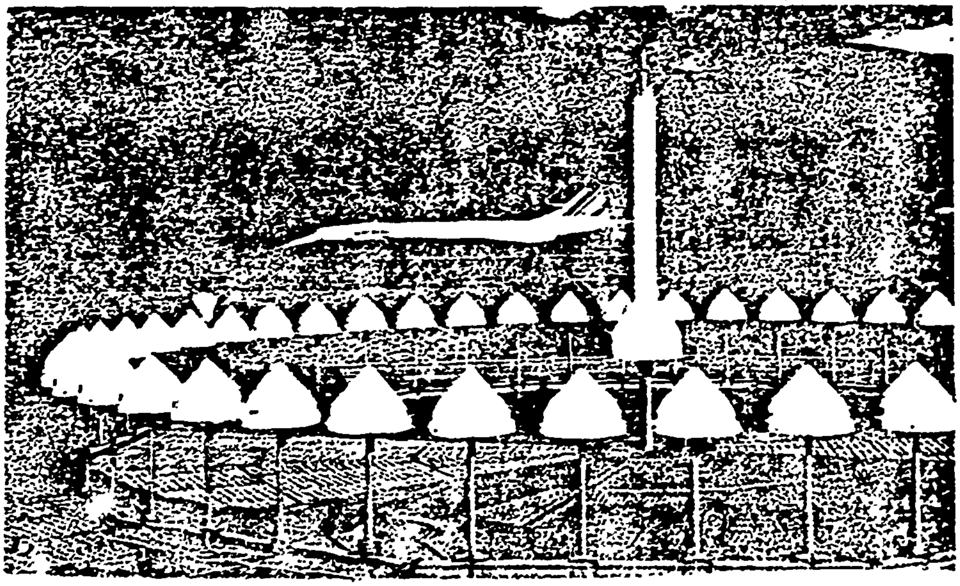


(3) TRS 2105 "Tiger" G low altitude observation radar.

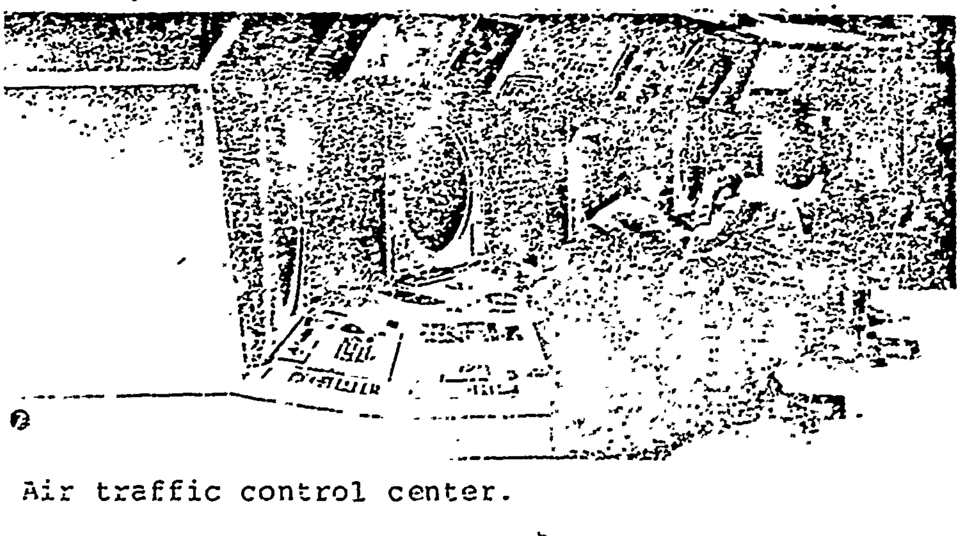


(4) Air defense command system mobile control and reporting center.

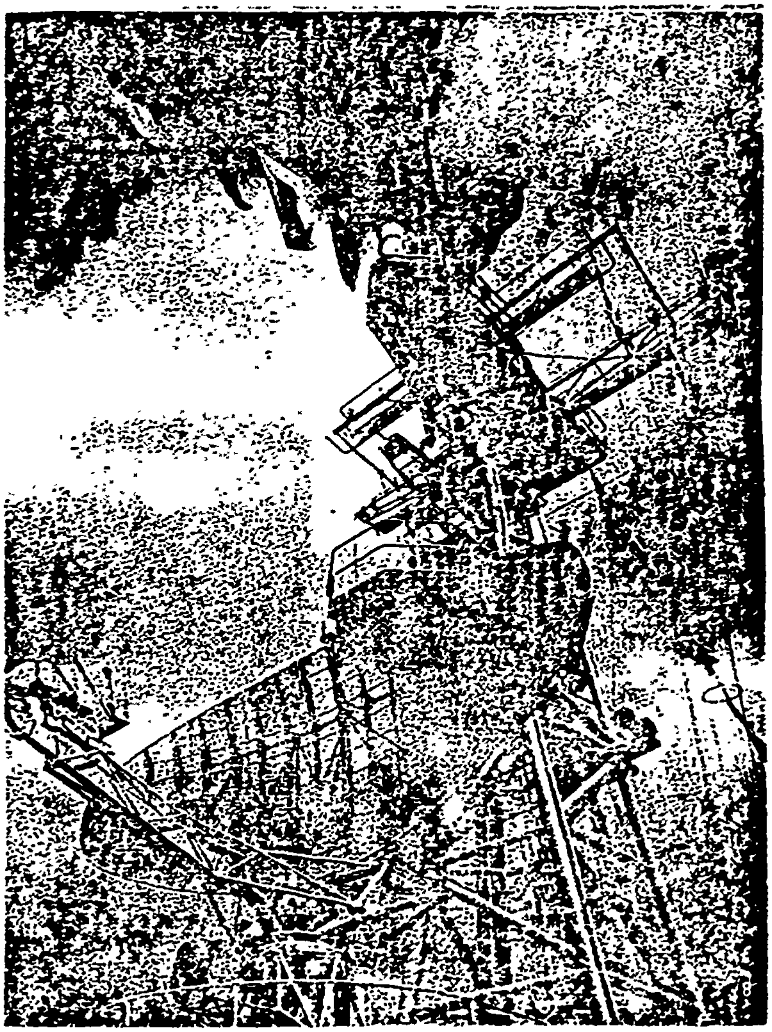
(5) Air defense command system mobile intercept (unclear) operating station.



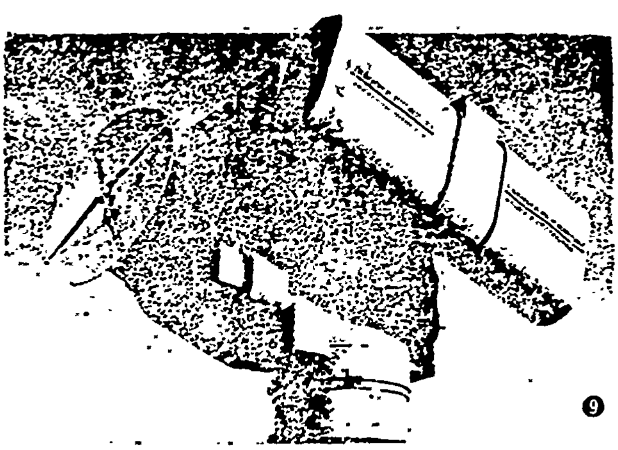
(6) VOR 512 Doppler aerial flight guidance assisting equipment.



(7) Air traffic control center.

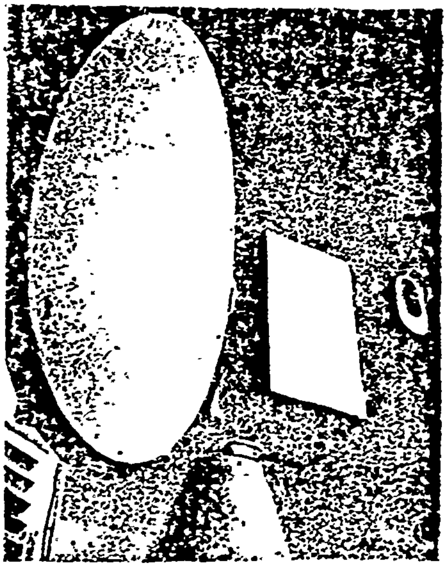


(8) Jupiter II SL wave band shipboard long range air observation radar.

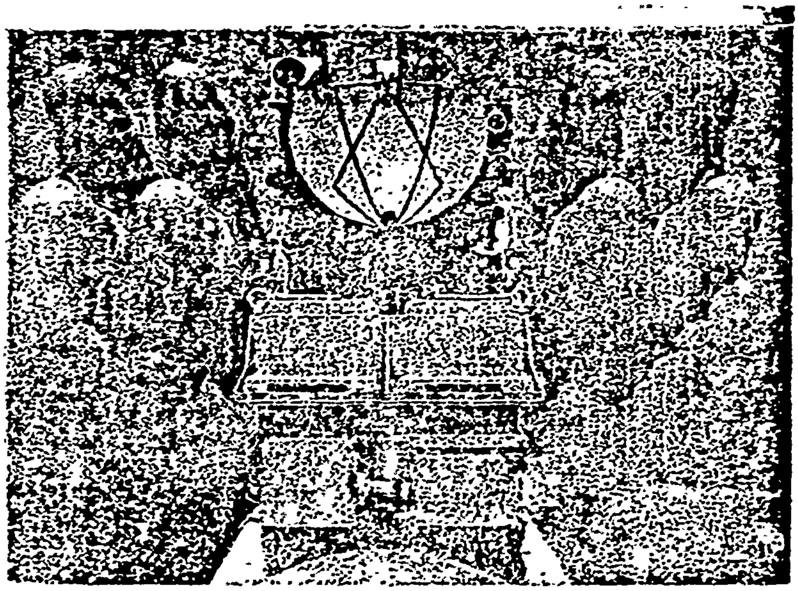


(9) Canopus shipboard fire control system.

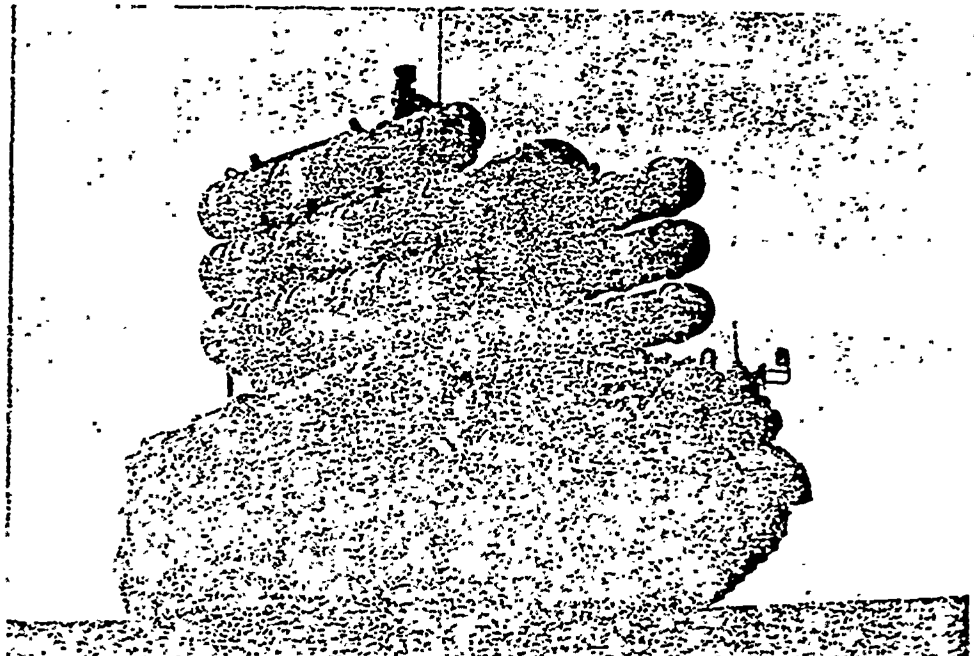
(10) Castor II C fire control radar.



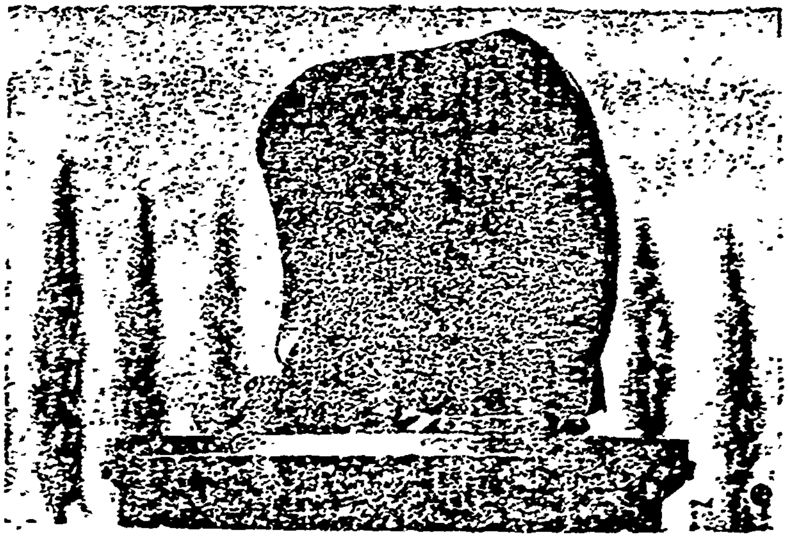
(11) Castor II J
fire control radar.



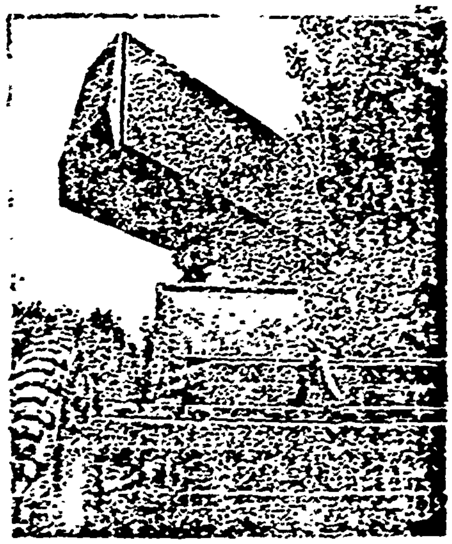
(12) Crotale missile system
tracking radar.



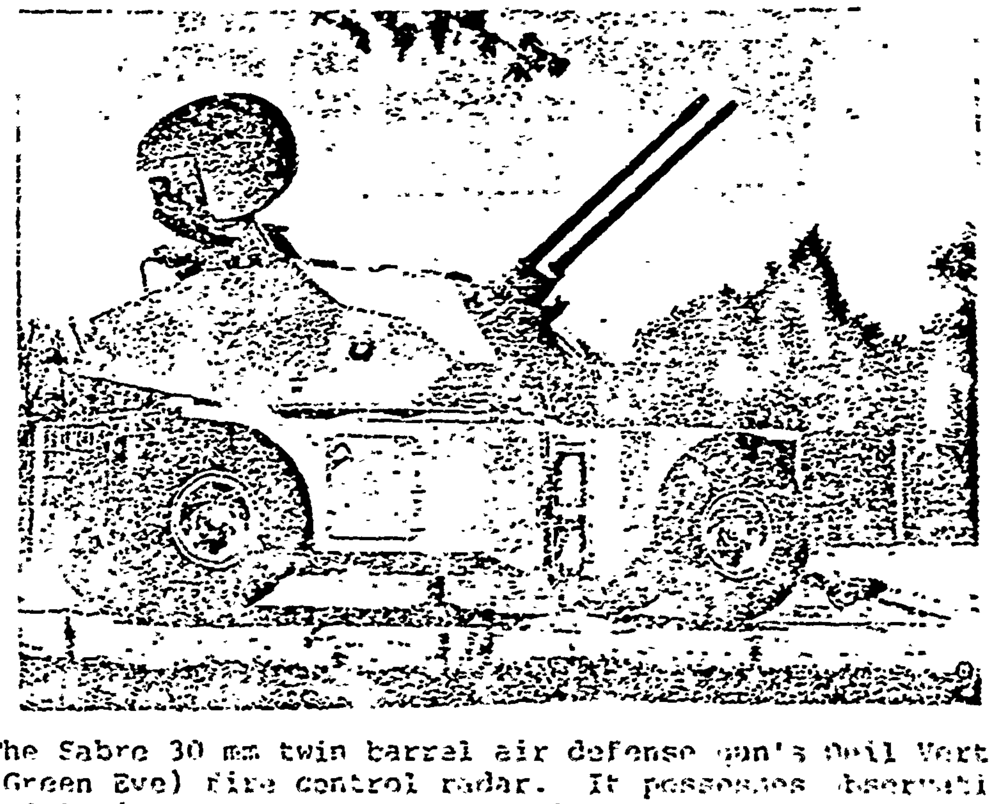
(13) Shahine ground to air missile
system fire control radar.



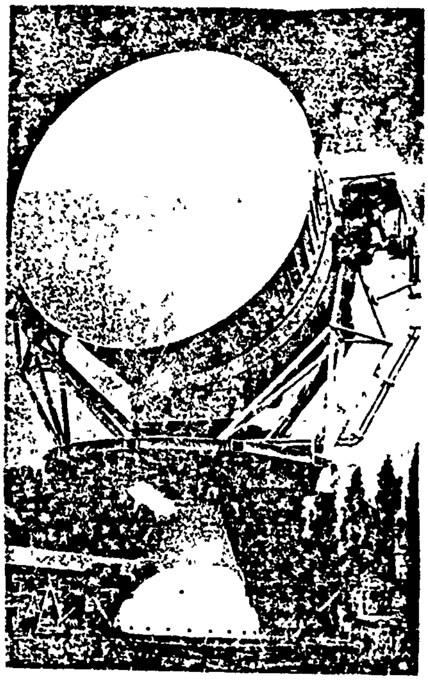
(14) TRS 2620 Gerfaut super-low altitude target acquisition radar.



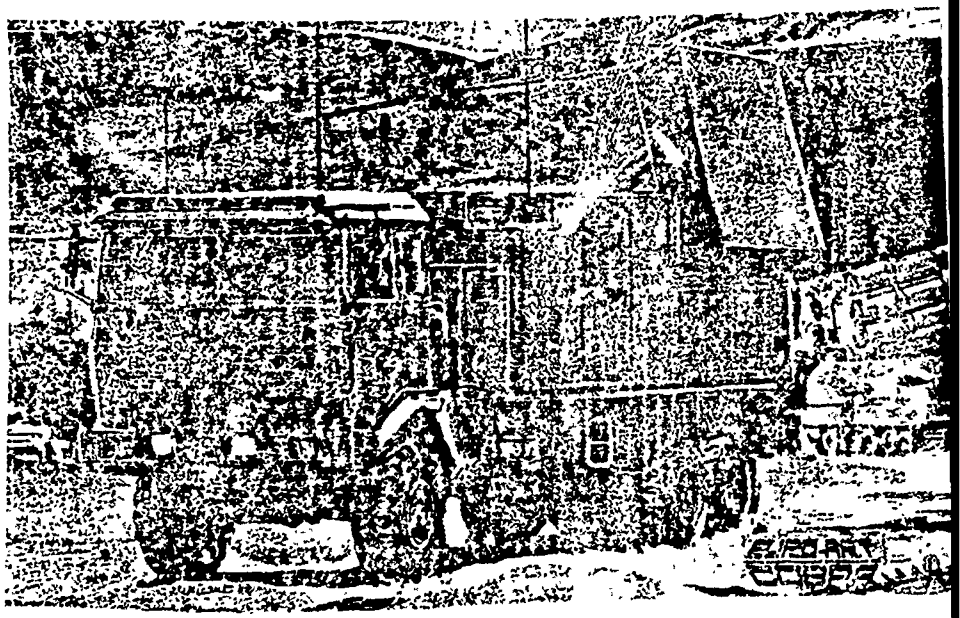
(15) TRS 2630 "Mastiff (coarse haired dog)" Radar.



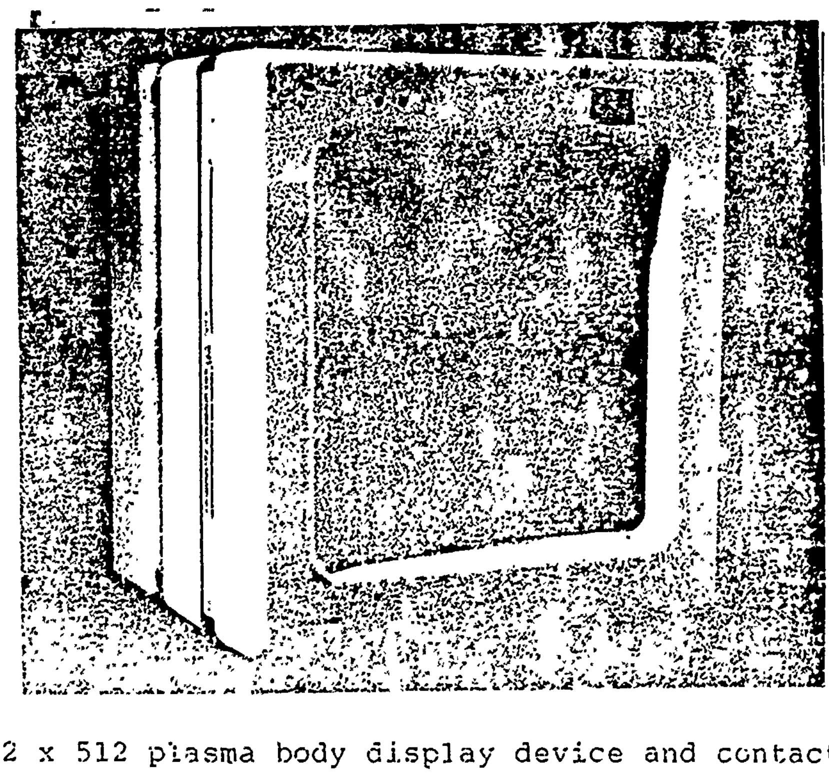
(16) The Sabre 30 mm twin barrel air defense gun's Oeil Vert (Green Eye) fire control radar. It possesses observation and lateral scan, lateral tracking capabilities.



(17) Artois three coordinate radar.



(18) New model counter-artillery radar.



(19) 512 x 512 plasma body display device and contact sensitive output equipment.

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